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DETERMINING STAFFING LEVELS FOR CONTINGENCY CONTRACT ADMINISTRATION SUPPORT

THESIS

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Abstract

Since the collapse of the Berlin Wall in 1991, the U.S. has been provided with a new set of domestic, international, economic, and national security challenges which have forced the DoD to redefine the way it operates. Internationally, the U.S. military has participated in numerous contingency operations in which the Defense Contract Management Command (DCMC) has provided contract administration for logistics support contracts. Ascertaining an effective and efficient staffing level for a contingency contract administration team during these operations has become a concern for DCMC.

This thesis investigates different manpower models used by stateside contracting organizations which may be useful for determining staffing for contingency contract administration teams. Specifically this thesis seeks to determine which manning model methodologies offer the best practical solution to contract administration team staffing during contingency operations. This research suggests that certain features of the contingency environment, such as increased operating tempos, infrastructure, culture, and troop strength, interact to affect the level of contracting support required during a contingency operation. The results of the study discussed here suggest that manning models which use work load taskings as their primary driver are the most useful in determining contingency contracting staffing levels. While the researcher offers no significant results, important contributions are made in laying the groundwork for understanding the staffing problem and developing a realistic manning model.

DETERMINING STAFFING LEVELS FOR CONTINGENCY CONTRACT ADMINISTRATION SUPPORT

I. Introduction

General Issue

Our nation's military forces in recent years have experienced tremendous changes. The Soviet block collapsed in 1991, forcing the US to redefine its national military strategy. Our nation's forces no longer face a major and protracted conflict in Europe. Rather the Post-Cold War world presents a new set of political, economic, and military security challenges for the United States. What the military faces:

> runs the gamut from highly realistic training for war, to peace operations, to deterring aggression, to staying ready all over the world from the Arabian Peninsula to the Korean DMZ. So, in the post-Cold War world, change and uncertainty will remain our only constants; and readiness for the unexpected, our only recourse. (Shalikashvili, 1997)

At the same time, the military has steadily reduced its budget and cut its manpower. Since 1989, the military has reduced the active forces by 700,000 people; which is about a third of the active force. However, in a typical week over 40,000 service men and women are participating in fourteen separate operations around the globe (Shalikashvili, 1997). With an increased operating tempo and a reduction in resources, it has been increasingly important for the military to develop realistic methods of determining manpower requirements to effectively and efficiently carry out its missions.

Problem Statement

Recently, Contingency Contract Administration Services (CCAS) has become a major mission for the Defense Contract Management Command (DCMC). Specifically, DCMC is charged with administering the U.S. Army's Logistics Civil Augmentation Program (LOGCAP) and the U.S. Air Force's Civil Augmentation Program (AFCAP) contracts. These contracts provide contractor facilities and logistics support for U.S. forces deployed during contingency operations.

Consequently, DCMC has formed Contingency Contract Administration Services teams to augment contract administration offices around the world. These teams deploy to the theater of operations to perform a full range of contract administration services for its customers, including: contract administration, property administration, and product quality assurance. Recent examples of the LOGCAP contract and CCAS team support include contingency operations in Somalia, Rwanda, Haiti, and the Balkans.

While contingency contracting has been a military mission support function for quite some time, the LOGCAP contract and DCMC's role in administering this contract has not. It has only been since 1990 that CCAS teams have deployed to administer the LOGCAP contract. In Somalia and Rwanda, the CCAS teams consisted of a few people administering the contract in a relatively contained geographic area. However, the operations in Haiti and the Balkans showed an increase the scope of the mission and geographic dispersion of deployed troops, which increased the complexity of LOGCAP support. Consequently, the number of DCMC personnel required to administer the contract also increased.

In November of 1996, the Army Audit Agency (AAA) reviewed the LOGCAP contractor's operations as well as DCMC's contract administration efforts in the Balkans. The major deficiency noted by the AAA investigation was that they felt the CCAS teams were not adequately staffed (DCMC, 1996). Specifically, AAA felt that additional quality assurance personnel were needed to adequately monitor the contractor's operations.

In response to the AAA report, DCMC maintained that increasing the number of personnel administering the contract is an inefficient use of human resources. DCMC believes that successful contract administration involves teaming with the contractor to ensure that the government's requirements are met (DCMC,1996). However, deciding how many members are required for the government's team is not easily determinable during contingency operations. Therefore, ascertaining an effective and efficient staffing level for CCAS teams during contingency operations is a significant concern for DCMC.

Purpose

The purpose of this thesis is to investigate different manpower models used by CONUS contracting offices which may be of use in determining CCAS team personnel requirements. In this research effort I intend to answer the following question: *"Which of the most commonly employed CONUS manning model methodologies offers the best practical solution to the problem of staffing a contingency contracting operation?"*

Scope of Research

A number of manpower models exist in the commercial world and the Department of Defense which could be examined (Jaquette, Nelson & Smith, 1977). As a matter of research practicality and scope, I selected three of the widely used CONUS models: U.S. Army Corps. of Engineers Research Laboratory Model, Air Force Material Command Objective Center Manpower Model, and the Air Force Material Command Manpower Requirements / Force Sizing Model. Specific issues that were considered in selection of the models include: the purpose of the original application of the model, data required, data availability, and the ease of application to this research effort.

Plan of Thesis

Chapter II of this thesis provides an overview of the need to accurately assess human resource requirements during contingency operations. It begins by describing contingency operations and the importance of the role played by contracting organizations during such operations. Next the policies regarding current acquisition procedures and the move toward increased reliance on contractors' processes are discussed. Finally, Chapter two concludes with a brief examination of the three selected manning models.

Chapter III examines each of the three manning models discussed in Chapter two. The examination includes a review of each model's background, their assumptions, the data required to run each model, and the formulation of each model. Following the examination of each model is a discussion of the environmental factors that influence the

contracting staffing levels during a contingency operation. Finally this chapter concludes with an analysis of the adaptability of the models to contingency contract administration.

In Chapter IV I report the results of the model applications. Specifically, I describe the recommendations of each model, the specifics concerning variable manipulation and model sensitivities. The chapter ends with a statistical comparison of the model recommendations to an established baseline.

Finally Chapter V provides a summary of the research findings, draws conclusions based on the research findings, and makes recommendations for improvements in both the present study and future research efforts.

II. Literature Review

Chapter Overview

This chapter provides an overview of the need to address the problem of staffing contingency contracting organizations during contingency operations. It begins by describing contingency operations and the importance of the role played by contracting organizations during such operations. Next, there is an examination of the policies regarding current acquisition procedures, as well as a discussion on the move toward increased reliance on contractors for services that were once performed organically by the Military. Following this is a brief review of personnel models in the DoD. Concluding this chapter is an examination of three manning models that have been used by US Army and the US Air Force for determining the required manning levels of CONUS contracting organizations.

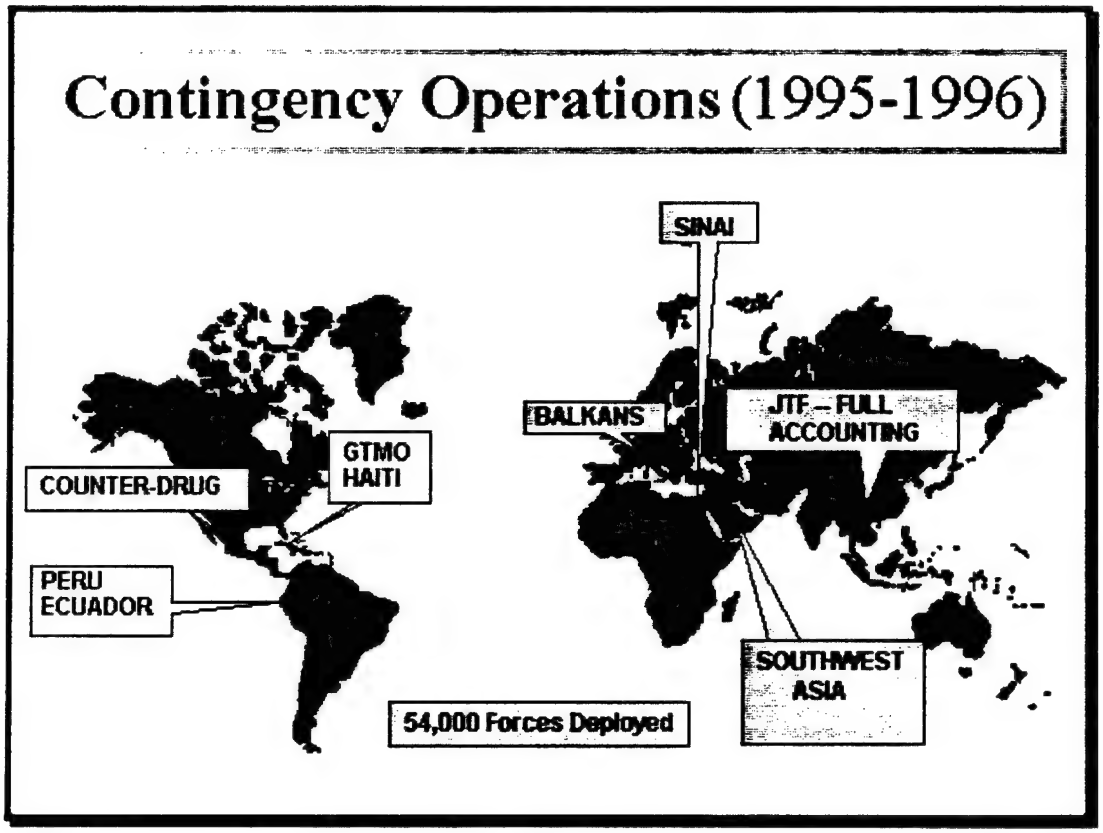
Contingency Operations

The collapse of the Soviet bloc between 1989 to 1991, forced the U.S. to redefine its future military strategy. On 21 February 1991, Secretary of Defense Dick Cheney, revealed this new strategy in an address to the Senate Armed Services Committee.

> The most important change reflected in this new strategy is that we no longer are focused on the threat of a Soviet-led, European wide conflict leading to global war...The new strategy shifts its focus to regional threats and the related requirements for forward presence and crisis response...the regional contingencies we might face are many and varied...One trait most of them share, however, is that they will arise on very short notice and therefore require a highly responsive military capability. (Cheney, 1991:9,11)

As a result of this change in strategy, the U.S. military has increasingly been called upon to participate in contingency operations around the globe. As Figure 1 indicates 54,000 U.S. military personnel were deployed to eight different contingency operations in two the year period of 1995 to 1996.

Figure 1. Recent Contingency Operations



Joint Chiefs of Staff Publication 1-02 defines a contingency operation as an emergency involving military forces caused by natural disasters, terrorists, subversives, or required by military operations (U.S. Army FM 46-1). Contingencies are usually politically sensitive military activities characterized by short term, rapid projection or employment of forces in conditions short of full scale war. They are often undertaken in

crisis avoidance or crisis management situations requiring the use of military instruments to enforce or support diplomatic initiatives (Killen & Wilson, 1992: 6). Contingency operations include, but are not limited to:

1. Unconventional warfare
2. Disaster relief
3. Security assistance
4. Shows of force and demonstrations
5. Noncombatant evacuations
6. Rescue and recovery operations
7. Strikes and raids
8. Peacekeeping (U.S. Army FM 100-20).

In the post Cold War era, U.S. military participation in these types of operations has steadily increased. Since 1991, U.S. military forces have participated in contingency operations in countries such as Somalia, Rwanda, Haiti and most recently, Bosnia-Herzegovina, for the purposes of humanitarian relief and peacekeeping. The general consensus of U.S. Military leadership points to more involvement in these types of deployments (Shalikashvili, 1996).

These operations differ from combat-oriented military deployments in several ways. They normally involve rapid deployment of forces, with minimal time for planning, coordinating, and preparing for the operations after the forces arrive. Due to the uncertainty of the situation, contingencies require plans, rapid response, and special procedures to ensure the safety and readiness of personnel, installations, and equipment. As a result, these missions put logistics at the center of the assigned mission (Shrader, 1996: 1).

Logistics support is the procurement, distribution, maintenance and replacement of material, personnel and equipment (American Heritage Dictionary, 1985: 740). It also involves mobilizing industry, obtaining utility services, ensuring medical services, and conducting scientific research. One of the most important facets of logistical support in contingency operations is contracting.

Contingency Contracting

Contracting is the element of the logistical support system which provides equipment, supplies and services to U.S. forces. The Federal Acquisition Regulation, FAR 2.101 defines contracting as:

> purchasing, renting, leasing or otherwise obtaining supplies or services from non federal sources. Contracting functions include preparation of description of supplies and services required, selection and solicitation of sources, preparation and award of contracts, and all phases of contract administration.

Therefore contingency contracting is the provision of essential supplies and services needed to sustain the mission (Army FAR Manual No. 2). Two methods exist for procuring supplies and services for units deployed to a contingency. These methods are CONUS contracting and contingency contracting. CONUS contracting involves obtaining the required supplies and services in the United States that are then sent to the theater. Contingency contracting is characterized by having contracting officers deploy with the units to procure the necessary supplies or services within the theater of operations (Killen & Wilson,1991: 5).

Traditionally, contingency contracting officers are deployed with the units for which they are providing support. The process of deploying and setting up a functioning contracting office in theater should take place when the advanced party is deployed (Hagel, 1992: 8). This is a process that takes time and involves activities ranging from setting up desks to generating contractual documents and making payments. In addition there is usually a learning curve that must take place, which involves getting acclimated to the environment, operations, and local customs.

In an effort to alleviate the time lag that may exist in establishing a functioning and effective contracting office, the U.S. Army has developed and awarded a contract which provides civilian contractor support during contingencies. The concept of using civilian contractors to provide supplies and services dates back to the Revolutionary War. However, the concept of preplanning for civilian contractor support really began to take shape after the Vietnam War (U.S. Army FM 63-11). In 1985 the U.S. Army formalized this concept with the Logistics Civil Augmentation Program, which had Army components of regional unified commands individually identify and contract for their supply and service requirements (Army Regulation 700-137). In 1992, LOGCAP was restructured to incorporate a single, worldwide, logistics, engineering and services contract to pre-plan for theater facilities and logistics support services in time of war or any other crisis.

LOGCAP is primarily for use in areas where no multilateral or bilateral agreements or treaties exist. This contract focuses on base / logistics camp construction, operations, and field services. It also includes traditional logistics functions such as

weapon system maintenance, material management, transportation, and port operations. Specifically, the contractor is required to provide a generic capability plan for logistics, construction and engineering support for 20,000 troops in five base camps for up to 180 days. Some recent examples of LOGCAP support include contingency operations in Somalia, Rwanda, Haiti, and Kuwait.

The advantages of the LOGCAP program are: (a) Provides rapid response - the contract is in place and preparatory planning in underway prior to initiation of an event. (b) Quick and responsive support - within 15 days after notification, the contractor is required to start providing support to troops arriving in theater.(c) Capitalizes on existing global/regional corporate resources - contractor uses its own managerial assets and can rapidly subcontract with local or regional suppliers. (d) Reduces the contracting burden - LOGCAP is captured in only one contract which needs to be administered versus numerous contracts and purchase orders in process at a contingency contracting office (U.S. Army FM 63-11).

Current Acquisition Policies on Contract Administration

Leveraging civilian support for what is traditionally considered a military or governmental function is not a new concept. Over thirty years ago, the U.S. government established a policy that it should rely on - not compete with - the private sector for goods and services. Issued in 1955, the Bureau of the Budget Bulletin 55-4 instructed agencies to rely solely on commercial sources of supply because of the potential to reduce costs. In 1967 the policy shifted to introduce competition between government-operated commercial activities and the private sector. In 1983 OMB circular A-76, "Performance

of Commercial Activities" directed agencies to conduct efficiency studies of their activities to determine the most efficient and effective operation possible to enable the in-house workforce to be more competitive with the private sector (GAO/GGD 89-6).

The A-76 studies compare the costs of providing the commercial service in-house with those of contracting it out. In the public sector contracting out is a common practice used to curb costs. Private firms can offer services at lower costs for a variety of reasons: (a) competition encourages efficient operations, (b) freedom from bureaucratic procedures, and (c) flexibility to control compensation costs and employment levels. The current trend in the government is to reduce its size and to reduce the costs of operating. Outsourcing and privatization are the current methods for accomplishing those goals. Outsourcing is the transfer of a function previously performed in-house to an outside provider, while privatization is the transfer of control of a business asset (or capital) and the associated activity (Department of the Air Force, 1996).

The A-76 program distinguishes commercial activities from inherently governmental functions, to which A-76 does not apply. In the DoD a governmental function is defined as:

> ...one that is so intimately related to the public interest as to mandate performance of Department of Defense employees. These functions include those activities requiring either the exercise of discretion in applying governmental authority or the use of value judgment in making decisions for the government. (Keating, Camm & Hanks, 1997:5)

These functions include criminal investigation, program management, regulation of industry and commerce, control of the Treasury, and tax collection.

In 1988 a GAO report entitled Federal Productivity: DoD's Experience in Contracting Out Commercially Available Activities outlined the activities that the DoD had reviewed in its A-76 studies from fiscal year 1979 to fiscal year 1987 and their claimed savings. Ten out of the twenty-five activities outlined, are logistics support functions that are performed by the LOGCAP contractor in contingency operations.

To support national security objectives in the most efficient and cost effective way, the DoD must concentrate its resources and activities in the areas most directly related to the accomplishment of its core mission, defense of our nation. In order to concentrate on its core mission the DoD has increasingly relied on outsourcing and privatization to transfer those activities considered non-core.

In 1992, Vice President Al Gore led the National Performance Review in an effort to study how to make government work more effectively and efficiently. One of the major criticisms of the government bureaucracy was its procurement system. In the National Performance Review, federal agencies were given the following guidelines for their procurement systems: (a) move from rigid rules to guiding principles, (b) change or eliminate government unique rules which create more bureaucracy, (c) increase reliance on the commercial marketplace (Perry, 1994).

As a result of this guidance, Secretary of Defense William Perry, issued a memorandum called, Acquisition Reform: A Mandate For Change in February of 1994. This memo calls for reducing acquisition costs through adopting the business practices characteristic of world class suppliers. The memo further states that The Carnegie Commission on Science Technology and Government calculated the overhead, or

management and control costs associated with the DoD acquisition process at about 40% of the DoD acquisition budget, as compared to 5% to 15% for commercial firms.

In December of 1994, the DoD contracted with the management consulting firm of Coopers and Lybrand to study the impact of DoD's acquisition regulations and its oversight requirements on its contractors. Coopers and Lybrand identified over 120 regulatory and statutory "cost drivers" that increase the price that DoD pays for its goods and services. Specifically three of the top ten cost drivers were; (a) the DoD quality program requirements (MIL-Q-9858A), (b) contract specific requirements not codified in statutes, regulations or specifications, and (c)Defense Contract Audit Agency and Defense Contract Management Command oversight (GAO/NSIAD,1996).

In order to reduce the overhead associated with DoD acquisition, the Perry Memo directed that the DoD should :

> Ensure that oversight, testing and inspection (both internal and external), when necessary to ensure compliance with enunciated policies or requirements, is performed in the least obtrusive manner necessary to add value to either the overall process or the particular acquisition, consistent with the risk of impact to the government in the absence of such oversight...Shift from a management philosophy that attempts to achieve high quality and performance through after-the-fact inspections, to one that prevents defects through controlling its processes, and reviewing the process controls of its contractors.

Oversight, as it is called under the pre-Perry Memo, required formal government involvement in almost everything a contractor did. Government review and approval was required prior to any action that was not specified in detail in the contract. However, under the "new way" of doing business mandated by the Perry Memo, oversight has

switched to the concept of insight. We assume the contractor knows how to do its job and that as a result of the bidding process the contractor has proposed its most efficient and effective approach. The contractor's proposal should outline its processes for managing the design, manufacture, and quality of its product, including metrics. The government's insight involves reviewing the metrics to assure that the contractors are supporting the processes and requirements that they agreed to when they signed the contract. DCMC operates under this belief in their CONUS operations as well as in their contingency contract administration efforts (DCMC, 1996).

In this era of acquisition reform, increased emphasis on reducing the oversight burden the DoD places on its contractors and increasing involvement in military operations other than war, it is essential for DoD contract administration functions, supporting the war fighter to become as "lean" and efficient as possible without jeopardizing contract performance. One of the methods of becoming a "lean" contract administration organization is to determine the minimum number and types of personnel required to effectively perform contract administration.

There are a number of methods available for determining the personnel requirements for these organizations. This study reviewed three approaches that have previously been applied to DoD contract administration organizations.

<u>Manning Models</u>

Manpower management is the art and science of formulating, choosing, and implementing policies affecting the manpower and personnel of an organization, while supporting its goals and objectives (Jaquette, Nelson & Smith, 1977: 5). In

implementing policies to support organizational objectives, manpower managers must evaluate possible alternatives to the greatest extent possible. One method for aiding in such evaluations is manpower modeling. Manning models are mathematical tools employed by manpower managers to (a) determine manpower rerquirements for current operations, (b) manage assignements, and (c) forcast future manpower needs.

In a 1977 RAND Corporation study, Jaquette, Nelson, and Smith identified over two hundred manpower models used in the DoD. They classified each model into one of three categories. The first category is requirements models, which are used for current staffing needs based on the skill of the personnel required to meet operational objectives. The second category is assignment models, which attempt to schedule personnel movements for training and job rotation. The third category is forecasting models, which are used to predict performance measures such as accession and retention, promotion and retirement costs. The majority of the DoD models examined by Jaquette, Nelson, and Smith in all three categories are concerned with the description and prediction of some small part of the total force, with the principal objective being that the desired level of capability is achieved at minimum cost.

As examined by Jaquette, Nelson, and Smith , there are a number of manpower models within the DoD with differing methodologies and objectives. This research effort evaluated three manpower models that have been used by CONUS contract administration organizations and which reflect the differences in these modeling approaches.

U.S. Army Corps of Engineers Research Laboratory (USACERL) Model

This model is the result of a study performed by the Directorate of Facilities Engineering, U.S. Army Support Command, Hawaii. Its purpose is to determine appropriate staffing levels for monitoring work performed on a services contract under the Commercial Activities (A-76) program on the island of Oahu, Hawaii. (Williamson & Hicks, 1991:7).

General Characteristics of Model

This model is based on the fundamental concepts of linear programming (LP). LP is a mathematical modeling technique that seeks to find an optimal solution to a given problem within the constraints of the stated resources that are assumed to be present. The mathematical model developed represents a set of relationships among the variables, resources, constraints, and the objective function. These variables may be cycle times, profits, costs, number of aircraft to send to a war, or number of human resources needed to perform a particular task (Gass:1970,4). LP produces a solution to the stated objective (minimum or maximum) by finding all solutions that simultaneously satisfy all of the problem's constraints (Andersen, Sweeney & Williams, 1994: 30). There are many possible solutions to a LP problem, however the objective is either the minimum or maximum of something, like personnel to staff a contracting office. The solution that best meets the objective is the optimal solution.

The USACERL model concentrates on the projected workload (variables) in determining staffing requirements (objective function). Specifically the model considers variables such as contract administration skill category, location where task is to be

performed, duration of the task performed, and frequency of the task performed, distance between work site and office, and driving time between office and work site.

Model Assumptions

The USACERL model makes the following assumptions (Williamson & Hicks, 1991:33):

1. The working day is assumed to be 8 hours.
2. Administrative (non-direct task) work is 60 minutes per working day
3. 30 minutes is allowed for breaks
4. Personnel are available for task work for 390 minutes each working day

Model Usefulness

This method for determining staffing requirements is useful, because the model takes into account the relationships among the variables, based on the operations of the processes involved. The data required for development of the model is readily available and easily quantifiable. Lastly, this method is an efficient way to determine staffing requirements when resources and constraints are known.

Model Limitations

One of the major limitations of this model is the number of underlying assumptions that must be made for efficient use of the model. These assumptions are: the decision variables and the coefficients must be additive; the relationship among the variables must be linear; the variables must be divisible; the variable values can not be infinite, and the data behind the variables must have a high degree of certainty (Schniederjans, 1984:29-31).

This acts to limit the applicability of the USACERL model to all situations because real life can not always be represented in the method required to satisfy LP's assumptions. The true relationship among variables may be quadratic or exponential or the data that must be relied upon may not be as highly accurate as that needed for LP. Lastly, there may not be any constraints on the problem or there may be too many constraints, which prevent obtaining a feasible solution.

AFMC Objective Center Manpower Model

Another method for determining staffing levels is the Air Force Material Command's Objective Center Manpower Model (ASC/PK 1996). This model is an algebraic formula, which generates a staffing level based on the population of the installation that a CONUS operational contracting office supports.

General Characteristics of Model

This model is primarily driven by the basic population of the installation being supported. It however takes into account several variances that affect the resultant contracting office staffing level. These variances are applied only if yes can be answered for the following questions. Does the operational office support :

1. The base medical treatment center
2. A major or unified command
3. Laboratories
4. Government Operated Civil Engineering Store
5. International Merchant Purchase Authorization Card (IMPAC) program
6. A-76 contract Administration
7. Miscellaneous missions support

Each one of the above variances when included as part of the model's input increases the generated staffing requirement. The actual numbers assigned to these variances are estimated by the local manpower office at the installation.

Model Assumptions

The current form of the AFMC Objective Center Manpower Model makes the following assumptions:

1. For every 417 personnel on the installation, 1 contracting person is required.
2. There is no distinction between contract administration skill categories.
3. The minimum number of personnel required for the operational office is 23.
4. A linear relationship exists between base population and required contracting personnel.

Model Usefulness

This method is a useful tool when the number of personnel at an installation is known or can be estimated with a high degree of certainty. Since all organizations on a base utilize the supplies and services acquired by the operational contracting office, the population of the installation can be thought of as "customers". These customers determine their internal service/supply needs and present them to the contracting office, whose responsibility is to acquire these services/supplies. Knowing the base population allows for a quick and efficient method of determining the amount of personnel required to staff the contracting office.

Model Limitations

However, there is major limitation to this method. Not all installations will require the same amount of contracting support due to MAJCOM and mission differences. One installation, like Wright-Patterson AFB, may have flying units, a hospital, scientific labs,

an academic unit, and other base tenants, which would require increased contracting support to provide for the variety and amounts of supplies and services required by these units. Another installation, like Los Angeles AFB, does not even have a flying unit, a hospital, labs or numerous tenants. It mainly consists of an acquisition organization. So even if the base populations are identical, not all installations will require the same contracting tasks to be performed at the same rates and/or at all. This limitation acts to inhibit the model's applicability to all situations.

Force Sizing/Manpower Requirements Model

The last method that was examined is called the Force Sizing / Manpower Requirements Model (ASC/MO 1994). The model has been used by Aeronautical Systems Center to determine the staffing level required to support its Air Force customers (units) during a wartime situation. This model looks at the current peacetime manning level(baseline), based on the organization's manning document, and projects a future staffing level for different wartime situations by applying different weighting factors as determined by the scenario.

General Characteristics of Model

This is an algebraic model takes into account the contracting support actions that may be affected by an environment with an increased operating tempo, such as in war or a contingency situation.

Model Assumptions

The Force Sizing/Manpower Requirements Model makes the following assumptions:

1. Some contracting rules are waived to expedite contracting support
2. Substantial demand is placed on contracting to provide emergency local purchase support
3. The regular mission of supporting the base will remain unchanged
4. Increased Workload
    i. military support functions contracted out.
    ii. commodity and equipment requirements increase by 50%.
    iii. construction new starts decreased by 50%.
    iv. contract quarters, transportation and personnel support will be required to accommodate transient population.
5. Hours of Operation – 6 days per week, 10 hours per day.
6. Unconstrained funding (ASC/MO 1994).

Model Usefulness

This model is a useful tool for determining the additional contracting personnel needed to support an increased operating tempo at a CONUS installation because it makes realistic assumptions about the affects of such an operations tempo on contracting support actions. This model takes into account the impacts to specific organizations and functions that provide support to base operations when increased operating tempos place increased demands on such support.

Model Limitations

This model is mainly limited by its assumptions. It may not be applicable to all installations during increased operating tempos due to the mission of that installation. If the mission of the installation includes airlift, such as Wright-Patterson AFB, there may be additional contracting support during a contingency or war if transient troops are passing through and need lodging, food, etc. In this scenario, Los Angeles AFB, would not be affected because it does not even have a runway. Only those installations significantly affected by a war or a contingency operation would need to utilize this

model. Installations, such as systems product centers, would not feel the same manning impact as an Air Combat Command or Air Mobility Command installation. In addition, this model is useful only when a contracting organization already exists, and merely needs additional personnel.

Proposition

All three methods above have been used for determining staffing requirements in CONUS DoD organizations during peace time conditions. I propose that *"CONUS models can be useful in predicting staffing needs during contingency operations."* While contingency operations are environmentally unique and different from CONUS operations, they are still operations nevertheless. These models are still useful for contingency contracting staffing because contingency operations require similar taskings and similar model dynamics. Once the idiosyncratic variances of a contingency operation are accounted for in the models, then their similarities to CONUS operations can be evaluated. Therefore, CONUS models are expected to be useful for the development of a contingency contracting staffing model.

Using historical data from Operation Uphold Democracy (US/UN operation in the Republic of Haiti, 1994-1995), I ran each of the three adapted manpower models to generate three separate staffing levels for the CCAS team and compared the results to a baseline number. The following chapter will describe the processes used to build these models and make the comparisons.

III. Methodology

Chapter Overview

This chapter describes the methodology employed by each of the three manning models discussed in Chapter II for determining CONUS based contracting organization staffing requirements. The review includes an examination of each model's assumptions, its variables, required data, and its sources. Next are short examples demonstrating each model's use. Following the review and examples of the CONUS models is a discussion of the procedures followed in adapting each model to CCAS team staffing. Specifically the sources of the data and their collection procedures are discussed. Lastly, the adaptation process and resulting models are presented.

CONUS Models

U.S. Army Corps of Engineers Research Laboratory Model

This is a linear programming model that determines the number personnel required for staffing and scheduling quality assurance inspections by optimizing contract administration task times.

Model Assumptions

The USACERL model makes the following assumptions (Williamson & Hicks, 1991:33):

1. The working day is assumed to be 8 hours.
2. Administrative (non-direct task) work is 60 minutes per working day
3. 30 minutes is allowed for breaks
4. Personnel are available for task work for 390 minutes each working day
5. Single skill category is assumed
6. Personnel are based at a single location

Variables

Previous research on staffing determinations using linear programming reveal some common variables that heavily influence processes such as contract administration. These variables are distance between work centers, travel time, skill requirements, task times, and task frequencies, labor costs, and material costs. (Lee et. al., 1979), (Lauer et. al, 1994), (Taylor, 1996), (Williamson & Hicks, 1991). The most important parameters of this model are workload demand, time available to personnel, and travel times between work sites.

Data Required and Sources

Williamson & Hicks analyzed the administration of facilities contracts for the U.S. Army Support Command on the island of Oahu, Hawaii in developing their model. Specifically, they categorized the work performed into tasks as well as the skills required to perform the tasks. Next contract task requirements, as specified in the facilities contracts, were analyzed for their frequency of performance. The duration of the identified tasks were determined from a review of the U.S. Army Support Command's records of task duration from previous facilities contracts. Lastly, a travel time network with distances between sites was constructed based on geographic dispersion and timing of travel routes.

Model Formulation

The following model represents the mathematical statement of finding the minimum number of personnel required to perform contract administration, specifically quality assurance (QA) inspections, for the U.S. Army Support Command in Hawaii.

The model assumes a single skill category and that all QA inspectors are based at a single location.

Let:

i or j = a site	i, j = 1....m
k = a skill category	k = 1....n
w = a working day	w = 1....W
p = class of inspection frequency	p = 1....P

Thus m is the number of sites, n the number of QA personnel, and W = 252 working days per year.

Given:

d_{ip} = duration of class p task at site i

h_{ip} = the need for class p task at site i

H_{IP} = {1 if d_{ip}>0, 0 otherwise}

a_{kw} = time available for inspector k on day w

t_{ij} = travel time between sites i and j

Find the following decision variables:

- the incidence of a visit by inspector k to a site i on day w given by:

  y_{ikw} = {1 if inspector k visits site i on day w, 0 otherwise}

- the sequence in which sites are visited represented by:

  x_{ijkw} = {1 if inspector k visits site j immediately after site i on day w, 0 otherwise}

- the assignment of a visit to inspector k on day w expressed by:

  z_{kw} = {1 if $\sum y_{ikw}$ >= 1 for i = 1..m, 0 otherwise}

- If q_{ikw} = inspection load of inspector k at site I on day w, then find q_{ikw} and the need for inspection visit to site I on day w expressed as:

  b_{iw} = {1 if $\sum q_{ikw} > 0$ for k = 1..n, 0 otherwise}

- The daily assignment of inspection tasks denoted by:

  s_{ikpw} = time spent at site I by inspector k to perform task p in day w

To minimize n, subject to:

Eq 1 $\sum\sum s_{ikpw} = d_{ip} f_p$ where i = 1....m, p = 1....P

Eq 2 $\sum s_{ikpw} - q_{ikw} = 0$ where i = 1....m, k = 1....n, w = 1....W

Eq 3 $\sum\sum y_{ikw} >= f_p h_{ip}$ for all i and p

Eq 4a $s_{ikpw} <= y_{ikw} M$ for all i,k,p,w where M is arbitrarily large

Eq4b $s_{ikpw} <= b_i M$ for all i,k.p.,w

Eq4c $y_{ikw} <= z_{kw}$ for all i,k,w

Eq 5 $\sum z_{ky} <= A$ for all k

Eq 6a $\sum y_{ikw} >= b_{iw}$ where $i = 2....m$, $w = 1....W$

Eq 6b $\sum y_{ikw} >= n$ where $w = 1....W$

Eq 7 $\sum q_{ikw} + \sum \sum t_y \, x_{ijkw} <= a_{kw}$ where $k = 1....m$, $w = 1....W$

Eq 8 $\sum x_{ikw} = \sum x_{jkw} = y_{ikw}$ where $i = 1....m$, $k = 1....n$, $w = 1....W$

Eq 9 $\sum x_{ijkw} <= \sum b_{iw}$ for all $S \in [2....m]$, $k = 1....n$

$y_{ikw} \in [0,1]$ for all i,k,w

Eq 10 $x_{ikw} \in [0,1]$ for all i,k,w

$b_{iw} \in [0,1]$ for all i,k,w

$z_{kw} \in [0,1]$ for all i,k,w

Eq 11 $w_{ikpw} >= 0$ for all i,k,w

$q_{ikpw} >= 0$ for all i,k,w

In the above formulation, constraints one to five are concerned with the assignment of daily inspection loads. Equation 1 implies that the total time spent by all inspectors at any site for class p inspection on day w is equal to the required inspection for that site and class of inspection. Equation 2 defines assigned workload for the inspector at a given site on a specific day. Since each class of inspection requires a certain number of visits per year, Equation 3 states that the number of visits to a site must be at least equal to that required for the most frequent class of inspection with positive demand. Equation 4a and 4b ensure that no inspection can be done at a site if it is not visited, while Equation 4c verifies that an inspector works on a day that he has to visit a site. Equation 5 restricts the number of working days for each inspector (Williamson & Hicks, 1991:33)

Equation 6a through 9 are routing constraints that ensure that visits are made with minimal travel time. Equation 6a and 6b ensure that the inspectors visit each site the required number of times. Equation 7 limits the time spent on the inspections and traveling to the length of the work day. Equation 8 ensures that an inspector leaves a site after visiting. Equation 9 eliminates sub-tours. Equation 10 contains intagrality constraints while Equation 11 ensures non-negativity (Williamson & Hicks, 1991:33).

AFMC Objective Center Manpower Model

This model is an algebraic formula which determines the manpower necessary for staffing a contracting office based on the population being serviced.

Model Assumptions

The CONUS application of the AFMC Objective Center Manpower Model makes the following assumptions:

1. For every 417 personnel on the installation, 1 contracting person is required.
2. There is no distinction between contract administration skill categories.
3. The minimum number of personnel required for the operational office is 23.
4. A linear relationship exists between base population and required contracting personnel.

Variables

The variables for this model are base population and mission variances. Base population is the sum of all of the military and civilian personnel permanently assigned to an organization operating on the installation. Mission variances are adjustments to the contracting office staffing as determined by the missions performed and contract support required by the organizations associated with the variances. The mission variance categories are: population support, medical treatment facility support, MAJCOM/Unified command support, Laboratory support, Various Missions support, Government Owned Civil Engineering Store (GOCESS) support, Quality Assurance Evaluator Program (QAE) support, International Merchant Purchase Authorization Card (IMPAC) program, and A-76 contract administration. The values attached to the variances are assigned by the Air Force Manpower Standard 12AO and are specific for each organization assigned to AFMC (AFMC/PKO, 1996).

Data Required and Sources

Once a determination is made as to the AFMC installation of interest, the base population and the applicable variances are the only data required to run the model.

Model Formulation

Let:

Y = Staffing level for base operational contracting office

P = Base population

V_i = Mission variance $\qquad i = 1....n$

The Objective Center Manpower Model is:

$$Y = 23 + (0.0024 * P) + (\sum V_i)$$

Using Wright Patterson AFB as an example to illustrate the model, the required operational contracting staffing level is:

V1 = population variance	= 9
V2 = medical center variance	= 5
V3 = MAJCOM variance	= 6
V4 = Laboratory variance	= 10
V5 = Various Missions variance	= 1
V6 = GOCESS variance	= 4
V7 = QAE variance	= 1
V8 = IMPAC variance	= 1

$$Y = 23 + (0.0024 * (18{,}973) + (V_1 + V_2 + V_3 + V_4 + V_5 + V_6 + V_7 + V_8)$$

$$Y = 23 + (0.0024 * 18{,}973) + 38$$

$$Y = 106.5 \text{ personnel}$$

Force Sizing / Manpower Requirements Model

The Force Sizing / Manpower Requirements Model allows base level and organizational manpower organizations determine manning requirements during times of increased threat, contingencies, and wartime (AFMC/PKO, 1994). An analysis of the peacetime force structure determines the baseline manpower level, which is then adjusted by applying weighting factors in order to calculate the additional personnel required.

Model Assumptions

The Force Sizing / Manpower Requirements Model makes the following assumptions:

1. Some contracting rules are waived to expedite contracting support
2. Substantial demand is placed on contracting to provide emergency local purchase support
3. The regular mission of supporting the base will remain unchanged
4. Increased Workload
    i. military support functions contracted out.
    ii. commodity and equipment requirements increase by 50%.
    iii. construction new starts decreased by 50%.
    iv. contract quarters, transportation and personnel support will be required to accommodate transient population.
5. Hours of Operation – 6 days per week, 10 hrs per day.
6. Unconstrained funding

Definition of Model Variables

The following is a list of the Force Sizing / Manpower Requirements Model variables as well as their definitions:

PMR - Peacetime Manpower Requirements - the in-place peacetime manpower requirements to support peacetime operations based on current authorizations or standards.

SAF - Sustained Availability Factor - an overall military/civilian conversion factor of 60% based on the relationship between a normal peacetime availability and a wartime emergency availability

WMB - Wartime Manpower Baseline - PMR * SAF

WAF - Wartime Adjustment Factor - the functional OPR's best estimate of the degree of change due to additional or deleted processes or tasks to support the the specified wartime scenario. WAF score of zero indicates deleting the process/task. WAF = 1 indicates a 50% increase in the process or task. WAF = 2 indicates an increase of 100%.

AWB - Adjusted Wartime Baseline - WMB * WAF

WWF - Wartime Workload Factor - the degree of change based on increases or decreases in logical workload drivers to support a specified wartime scenario. (i.e., peacetime population = 10000 and wartime population = 12000 then the WWF = 1.2)

WMR - Wartime Manpower Requirement - AWB * WWF (ASC/MO, 1994).

Data Required and Sources

The Force Sizing / Manpower Requirements Model requires the baseline population of the installation, the baseline organizational staffing level and the type of wartime or contingency scenario being analyzed by the manpower planner. The baseline installation population and the baseline organizational staffing level for the following example was obtained from Aeronautical Systems Center Manpower Office at Wright-Patterson AFB, OH during the first application of this model in April 1994.

Model Formulation

The following model is the result of applying the Force Sizing / Manpower Requirements Model to the operational and central support contracting office at the Aeronautical Systems Center in April 1994 based on the assumptions listed above.

PMR	SAF	WMB	WAF	AWB	WWF	WMR	
(FY94)		(pmr*saf)		(wmb*waf)		(awb*wwf)	
217	0.60	130.20	1.36	177.30	1.23	217.91	personnel

Model Adaptation

The remainder of this chapter discusses the methodology used to adapt the three manning models to determining the required staffing level for a DCMC CCAS team during contingency operations supported by the LOGCAP contract.

Data Sources and Collection

For this study, data was collected in five phases. In the first phase troop strength data and the CCAS team's actual staffing numbers were obtained from DCMC International District. DCMC has responsibility for administering the LOGCAP contract and assigning personnel to CCAS Teams during contingency operations. The data was collected via electronic mail on 14 July 1997 (Young, 1997). The data is based on DCMC's contract administration efforts from Operation Uphold Democracy from 1994-1995, in the Republic of Haiti. Operation Uphold Democracy was the United Nations and United States military operation which sought to restore order to Haiti and encourage free and democratic elections after a coup had overthrown the government. This event was chosen for three reasons: (a) availability of the data, (b) it was the most recently completed contingency operation to use the LOGCAP contract, (c) it is representative of the population of such operations.

In the second phase a review of the applicable contract administration tasks was performed. Specifically DCMC's operating instruction, One Book, was analyzed to establish a list of contract administration tasks to be reviewed in the next phase (DCMC, 1995).

In the third phase an expert panel, consisting of four U.S. Air Force contracting officers experienced in contingency operations, met to: a.) identify which contract administration tasks that are critical in a contingency environment, b.) determine the frequency of task performance, and c.) determine task duration. The subject matter experts chosen for this effort were selected from a pool of officers who have participated in a contingency operation as contracting officers for more than 90 days within the last three years. The following table lists the group's specific qualifications:

Table 1. Expert Panel Contingency Experience

Expert #	Contingency Location	Contingency Participation	CONUS Contracting Experience	Total Years in Contracting
1	Saudi Arabia	179 days	Operational and Systems Administration	8
2	Saudi Arabia	179	Operational and Systems Acquisition	8
3	Saudi Arabia	100 days	Operational	5
4	Haiti	179	Systems Administration	4

In the fourth phase the author's personal experience in Operation Uphold Democracy was used to screen the applicability of the tasks identified by the expert panel

for the subject contingency operation. Table 2 lists the results of the expert panel and the author's review.

Table 2. Results of Expert Panel

CCAS Team Contract Administration Tasks	**Task Duration (hrs per week)**	**Task Frequency (times per week)**
T1. Task Order Preparation	6 hrs	2
T2. Proposal Analysis	6 hrs	2
T3. Task Order Negotiation	4 hrs	2
T4. Task Order Modifications	4 hrs	2
T5. Customer Interface	4 hrs	12
T6. Task Order Progress Monitoring	4 hrs	12
T7. Task Order Inspection/ Acceptance	6 hrs	6
T8. Property Monitoring	4 hrs	7
T9. Property Disposition	7 hrs	7
T10. Administrative Duties	1 hr	7

In the last phase of the data collection, environmental variances, as presented Table 3, were developed by the author and his advisor in order to ascertain the effects that the operating environment has on contingency contracting support.

Table 3. Environmental Variances

	LOW	**MEDIUM**	**HIGH**
(F1) Infrastructure Condition	3	2	1
(F2) Operations Tempo	0	1	3
(F3) Cultural Barriers	0	1	3

Infrastructure condition refers to the degree of development of the infrastructure in the theater of operations in terms of road conditions, utility availability, economic stability

and government stability. Phase of the operation refers to the activities and timing of these activities during the operation. Cultural barriers refers to the degree in which American cultural practices and perceptions either help or hinder performing contingency contracting tasks. The numbers assigned to each factor variance represent the number of additional personnel required to account for the environmental influences on the contingency contracting function.

Adapting the USACERL Model

Since the contractor performing logistics support to U.S. troops is in control of many critical logistics functions such as: food storage and preparation, fuel storage and distribution, transportation of supplies, maintenance, and water purification, government performance of its contract administration tasks is critical to ensuring mission success.

USACERL model was intended to be used, unchanged except for the variable values because the CONUS contract administration skills and tasks, and the contingency contract administration skills and tasks were essentially identical. The required data was requested from DCMC, but was unavailable for the subject operation. The request for this data is included in Appendix C. Due to the unavailability of the required data to run the USACERL model, elimination of many the model's variables was necessary for adapting it to the contingency environment. Specifically, the following variables are omitted from this study: distance between work centers, travel time between work centers, task order type, and priority rating of the task order.

The following model presents a very general formulation of the linear program proposed by Williamson & Hicks for the U.S. Army Corps of Engineers, US Army

Support Command, Hawaii. The primary objective of this effort is to determine optimal number of personnel required to administer the LOGCAP contract during Operation Uphold Democracy based on the primary resource constraint, time available. For this study, I restrict my variables to task type, task duration and task frequencies as furnished in Table 2. by the panel of experts.

Model Assumptions

The following is a list of the assumptions that were made in formulating the adapted linear programming model.

1. Administrative support staff are not considered in the model. Only the primary functions for administering the LOGCAP contract (ACO, PA and QA) are included.
2. Personnel are available to work 12 hrs per day; 7 days per week.
3. All tasks are related to the standard task orders (i.e. one time / non-continuous tasks are not considered).
4. The contingency operation is "stable" (No major changes in workload or troop deployment).

Assumption number one was made because administrative support personnel do not directly contribute to the CCAS Team's primary mission of administering the LOGCAP contract. Instead, these personnel support the team by performing such functions as; in and out-processing, billeting, equipment issue, supply, and transportation. This function's manning level should be determined by the CCAS Team's commander.

Assumption number two is based on the collective contingency experiences of the expert panel and the author. The operation continues twenty-

four hours per day and seven days per week, and requires personnel to be available for the same amount of time.

Inevitably, there will be special purpose, one time task orders that will require additional work to be performed. This is a product of the dynamic environment in which a contingency operation exists. However, the third assumption is made because the continuous task orders for basic logistics services, which are essentially equivalent from contingency to contingency, are the primary drivers for the CCAS Team's workload. For the purpose of this study, any over and above work is assumed to be accomplished during the performance of the standard task orders.

The last assumption is made because this model represents a snapshot in time. Major changes in the contingency operation, such as troop level changes, geographical area changes, initial deployment or redeployment to the CONUS, all have distinct affects that place differing resource demands on the CCAS Team. Choosing the sustainment phase of a contingency operation eliminates the need for additional variables which are not easily quantified.

Model Formulation

Let: X1 = Number of Contracting Personnel
X2 = Number of Quality Assurance Personnel
X3 = Number of Property Administration Personnel

t_j = Contracting Tasks (tasks 1 - 5, and 10)
t_k = Quality Assurance Tasks (tasks 5 - 7, and 10)
t_m = Property Administration Tasks (tasks 5, and 8-10)

Lt_i = duration of task i where i = 1 - 10
Ft_i = frequency of task i where i = 1 - 10

$D1 = \sum (Lt_j * Ft_j)$ where j = hrs/task/week for tasks 1,2,3,4,5,10

$D2 = \sum (Lt_k * Ft_k)$ where k = hrs/task/week for tasks 5,6,7,10

$D3 = \sum (Lt_m * Lt_m)$ where m = hrs/task/week for tasks 5,8,9,10

Minimize: $\sum X_d$ where d = 1,2,3

Subject To:

$X1 <= 4$
$X2 <= 5$
$X3 <= 2$
$Xd >= 0,$ d = 1,2,3
$Xd =$ integer d = 1,2,3
$(Dd * 4) / Xd <= 336$ d = 1,2,3 (Dd * 4 = hrs/mo/task)

The constraints imposed on the personnel numbers (X1<=4, X2<=5, X3<=2) represent the maximum number of personnel allowed for each skill type as identified in Contingency Contract Administration Services, Appendix A of DCMC's One Book . These constraints restrict the maximum number of personnel to be no more than eleven per team. The remaining constraints force the model to generate only positive integer numbers and restrict the time available for work for each person to be less than or equal to the actual amount of time available working 12 hours a day for 6 days each week.

Adapting the AFMC Objective Center Manpower Model

The degree of contract support in CONUS contracting operations is directly affected by the number of personnel on the installation. Therefore, when applying this model to contingency contract administration of the LOGCAP contract, a determination of the troop strength in theater of operations being supported by the LOGCAP contract must be made.

Variables

Based on the data provided by DCMC for the Haiti event, there were approximately seven major base camps that the LOGCAP contractor was responsible for servicing under the contract provisions. All seven camps were geographically separated throughout the country to fulfill mission requirements. Each camp in a micro sense could be viewed as an installation, but for the purposes of this effort, the total troop strength for all seven camps was used. The decision to pool the troop numbers from all seven camps was made because; (a) accurate records were not kept concerning the exact numbers at each camp, (b) the operation in Haiti was restricted to the confines of its boundaries, therefore the contractor used the same support strategy at each camp, (c) logistics support for each camp was centrally controlled by the Port-au-Prince facility. The following table shows the troop strength during two different phases of Operation Uphold Democracy.

Table 4. Troop Strength During Operation Uphold Democracy

Date	**Phase of the Contingency Operation**	**Troops Supported by LOGCAP Contract**
Oct 1994 - Mar 1995	Deployment & Stabilization	18,000
Apr 1995 - Dec 1995	Sustainment	6,000

Model Assumptions

In adapting the AFMC Objective Center Manpower Model to contingency contract administration, a few assumptions and adjustments were made. The basic equation for this model is:

$$Y = 23 + (0.0024 * \text{population}) +/- \text{variables}$$

The y-intercept constant of 23 indicates that the base operational contracting organization must be staffed with at least 23 personnel even if there is a base population of zero. However, this is intuitively irrelevant because if zero personnel were at a base, no contracting support would be necessary. Base populations less than 480 personnel are outside the relevant range of the data used by this model. Due to this it is difficult to accurately asses Y-intercepts outside this range.

For the purposes of adapting this model to a contingency operation, this study uses a y-intercept of 3. If at least one troop is deployed in the theater in which the LOGCAP contract is being used, then there are at least three CCAS Team members (1 contracting, 1 quality assurance, 1 property administrator) administering the contract.

The slope of the basic model is 0.0024, which means that for every increase in troop strength of 417, one more contracting person is required. Based on discussions with the expert panel, this number seemed to be a reasonable and will be used as the slope for the contingency modified model. The assumptions to be used in the contingency modified model are summarized below:

1. For every 417 personnel in theater, 1 contracting person is required.
2. There is no distinction between contract administration skill categories.
3. The minimum number of personnel required for the CCAS Team is 3.
4. A linear relationship exists between troop strength and required contract administration personnel.
5. Environmental factors affect the staffing level

Model Formulation

The following formula is the AFMC model adapted to the contingency environment:

$$Y = 3 + (0.0024 * T) + (\Sigma V_i)$$

where: Y = number of contract administration personnel

T = troop strength

V_i = environmental variances $i = 1 \ldots n$

As discussed in the previous chapter, the AFMC model includes a number of variances used in adjusting the final number of personnel required to staff the contracting office. These variances take into account the impact on the base operational contracting manpower required to support tenant organizations and programs that are over and above the core contracting requirements for the installation.

Three environmental factors affecting the LOGCAP contractor's logistics support were identified in Table 3. The following tables show the scoring for Operation Uphold Democracy during the two phases of the contingency under consideration.

Table 5. Variance Scoring for Deployment and Stabilization

Deployment & Stabilization	**Low (0)**	**Medium (1)**	**High (3)**
Factor 1 (V_1) *Level of Infrastructure*		**X**	
Factor 2 (V_2) *Operations Tempo*			**X**
Factor 3 (V_3) *Cultural Barriers*		**X**	

Table 6. Variance Scoring for Sustainment

Sustainment	Low (0)	Medium (1)	High (3)
Factor 1 (V_1) *Level of Infrastructure*		**X**	
Factor 2 (V_2) *Operations Tempo*	**X**		
Factor 3 (V_3) *Cultural Barriers*		**X**	

Factor 2, Operations Tempo is the only factor that was scored differently from one phase to the next. During the Deployment and Stabilization phase, there is a great amount of activity taking place that increases the demand on contract support. These activities include: increased number construction projects; increased transportation of troops, equipment, and their supplies; and increased troop activities. The remaining variances did not change. Using the above environmental variance scores as assigned by the expert panel, the complete model as applied to the Haiti operation becomes:

$$Y = 3 + (0.0024 * T) + (V_1 + V_2 + V_3)$$

Force Sizing / Manpower Requirements Model

As described in Chapter II, this model generates the number of personnel required to augment a CONUS based contracting office during periods of increased operating tempos, such as during a war or a contingency. An examination of this model showed that it was not applicable to contingency operations for the following reason.

This model assumes an in-place contracting organization exists supporting peace-time activities at the installation. These in place organizations will experience an increase in their workloads due to contingency support. Since the very definition of a contingency implies that it is an event that does not currently exist, contingency contracting support also does not exist. When a contingency erupts, troops and equipment have to be deployed (including contracting personnel) as determined by the nature of the operation. Since no contracting function does or will exist until the actual event occurs, this model is removed from consideration for adaptation to staffing CCAS Teams.

Summary

This chapter examined each of the three manning models, including each model's background, assumptions, data required to run each model, and its formulation . This chapter also identified some possible environmental variances that influence contingency contracting operations. The USACERL Model and the Objective Center Manpower Model were adapted to the staffing of a contracting organization during contingency operations. The Force Sizing / Manpower Requirements Model was removed as an adaptation candidate to the contingency environment. The following chapter discusses the results of the methodologies pursued during the adaptation process.

IV. Results of Model Adaptation and Analysis

Chapter Overview

This chapter discusses the results of adapting the USACERL Model and AFMC Objective Manpower Model to determining the manpower requirements for DCMC contingency contract administration teams. The chapter begins with a brief review of the methodology used to adapt the CONUS manpower models to contingency contract administration team staffing. Following this is a report of the manpower numbers generated by the adapted models. Lastly the staffing level generated by each model model is compared to the actual staffing levels of the CCAS team during Operation Uphold Democracy, based on the proposition that, *"CONUS models can be useful in predicting staffing needs during contingency operations."*

Methodology Overview

As discussed in Chapter III, manning models used by CONUS contracting organizations were examined and adapted for possible use in determining the staffing levels of DCMC CCAS teams. Two models, the USACERL model and the Objective Center Manpower model, were chosen for adaptation.

Once the models were chosen a determination of the data required to run each models was made. DCMC provided data on the troop strength and actual CCAS manning numbers during Operation Uphold Democracy for the Objective Center Manpower model, but was unable to provide the workload, task, and distance data required for the USACERL model. As a result, a panel of experts with contingency contracting

experience convened to determine the types of tasks, their frequencies and their duration, as well as variance scores for the Objective Center Manpower model.

After data collection, the models were adapted as discussed in Chapter III based on the data that was available. The results generated by the adapted models and an analysis are discussed in the remainder of this chapter.

Results

Linear Programming Model

The results of the linear programming model, using the data provided by DCMC's *One Book* and the panel of experts is shown below in Figure 2. The major driver in this model is the expected task workload placed on the contracting personnel. Workload for each task is defined in this model as the time to perform a task multiplied by the number of times the task is performed. The estimated workload for a CCAS team for the tasks selected by the expert panel is 249 hours per week. Each person is available for 84 hours per week or 336 hours per month. Working within the constraints as shown in Figure 2., the model predicts that 2 contracting personnel, 2 quality assurance personnel, and 1 property administrator are necessary to effectively manage a workload of 249 hours per week. The model predicts that the contracting personnel would each work 190 hours per month, and have approximately 3 hours per day of slack (idle) time. The quality assurance personnel are each predicted to work 278 hours per month with 1 hour per day of slack time. The property administrator is predicted to work 336 hours per month with 0 hours each day of slack time.

Figure 2. Run 0 of Linear Programming Model

X1 = # of contracting personnel			d1 = (t1 + t2 + t3 + t4 + t5 + t10)	
X2 = # of quality assurance personnel			d2 = (t5 + t6 + t7 +t10)	
X3 = # of property personnel			d3 = (t5 + t8 + t9 + t10)	
TASKS	**TASK DESCRIPTION**	**TASK DURATION** (hrs per task)	**TASK FREQUENCY** (times per week)	**HRS per TASK per week**
t1	Task Order Preperation	6	2	12
t2	Proposal Analysis	6	2	12
t3	Task Order Negotiation	4	2	8
t4	Task Order Modification	4	2	8
t5	Customer Interface	4	12	48
t6	Progress Monitoring	4	12	48
t7	Inspection & Acceptance	6	6	36
t8	Property Status Monitoring	4	7	28
t9	Property Disposition	7	7	49
t10	Administrative Duties	1	7	7
				Hours per week 249
ASSUMPTIONS				
Work week is 7 days		Work hrs / week / person	Work hrs / month/ person	
Work Day is 12 hrs		84	336	
		Contracting (X1)	**Quality Assurance (X2)**	**Property (X3)**
Number of personnel		2	2	1
Skill Category Total Task Times		380	556	336
Hrs worked by each person		190	278	336
Slack time per month		146	58	0
Slack time / day / person		3	1	0

CONSTRAINTS *
Contracting Personnel <= 4
QA personnel <= 5
Property Personnel <= 2
X1 thru X3 > 0
x1 thru X3 > Integer
Each Person can not work more than 336 hrs per month
Total Personnel <= 11

* Personnel constraints as set by DCMC Manning Document (DCMC, 1996)

This problem was set up and computed using the Solver package in Microsoft Excel Version 7.0 for Windows95.

Objective Center Manpower Model

The results of the Objective Center Manpower Model, using the data provided by DCMC International and the panel of experts, are shown below. From October 1994 until March 1995, the approximate troop strength supported by the LOGCAP contractor

during the deployment and stabilization phase was 18,000. The variance scoring for V1-Level of Infrastructure, V2-Operations Tempo, V3-Cultural Barriers, was 1, 3, and 1 respectively. Therefore the required contract administration support predicted by the model for the deployment and stabilization phase of Operation Uphold Democracy is:

$$Y = 3 + (0.0024 * \text{Population}) + \text{Variances}$$

$$Y = 3 + (0.0024 * 18{,}000) + 1 + 3 + 1$$

$$Y = 51.2 \text{ contract administration personnel}$$

From April 1995 through December 1995, the approximate troop strength supported by the LOGCAP contractor during the sustainment phase was 6,000. The variance scoring for V1-Level of Infrastructure, V2-Operations Tempo, V3-Cultural Barriers, was 1, 0, and 1 respectively. :The required contract administration support predicted by the model for the sustainment phase of Operation Uphold Democracy is:

$$Y = 3 + (0.0024 * \text{Population}) + \text{Variances}$$

$$Y = 3 + (0.0024 * 6{,}000) + 1 + 1$$

$$Y = 19.4 \text{ contract administration personnel}$$

Analysis

Linear Programming Model

A sensitivity analysis was performed by changing the constraints and workload variables twenty three different times, as shown in Table 6.

Table 7. Results of Sensitivity Analysis

Run	Variable Adjustments	Result
0	None	5
1	No Manning Constraints	3
2	Relax Integer Constraint	4
3	Work Week = 6 days for 12 hrs Relax Integer Constraint	4
4	Work Week = 6 days for 12 hrs	8
5	Work Week = 6 days for 12 hrs No Manning Constraints	6
6	Work Week = 7 days for 8 hrs	7
7	Work Week = 7 days for 8 hrs Relax Integer Constraint	5
8	Work Week = 7 days for 8 hrs Relax Integer Constraint No Manning Constraints	5
9	Work Week = 6 days for 8 hrs	7
10	Work Week = 6 days for 8 hrs No Manning Constraints	7
11	Work Week = 6 days for 8 hrs No Manning Constraints Relax Integer Constraint	6
12	Work Week = 6 days for 8 hrs No Manning Constraints Task Frequency Doubled	14
13	Work Week = 6 days for 12 hrs Task Frequency Doubled	10
14	Work Week = 6 days for 12 hrs Task Frequency Doubled No Manning Constraints	10
15	Work Week = 6 days for 12 hrs Task Duration Doubled	10
16	Work Week = 6 days for 12 hrs Task Duration Doubled Task Frequency Halved	6
17	Work Week = 6 days for 12 hrs Task Duration Doubled No Manning Constraints Relax Integer Constraint	8
18	Work Week = 6 days for 12 hrs Task Duration Doubled Task Frequency Halved No Manning Constraints	6
19	Work Week = 7 days for 12 hrs No Manning Constraints Task Frequency Doubled	9
20	Work Week = 6 days for 12 hrs No Manning Constraints Task Frequency Doubled	10
21	Work Week = 6 days for 8 hrs No Manning Constraints Task Frequency Doubled	14
22	Work Week = 6 days for 8 hrs No Manning Constraints Task Duration Doubled	26
23	Work Week = 6 days for 12 hrs Task Duration Halved Task Frequency Halved No Manning Constraints	2

Each adjustment reflects the possible changes in the environment that may necessitate changes in the staffing levels (i.e., increased/decreased workloads, no manning constraints, increased/deceased work hours). On average the model predicted that 7.84 people were required to staff the CCAS team. The range of predictions ranged from a minimum of 3 persons to a maximum of 26 persons. The actual number of CCAS team members during Operation Uphold Democracy was 8, who each worked 12 hours per day 6 days per week.

Figure 2 below shows a histogram with a normal probability distribution curve fitted to the data generated by the variable adjustments, as well as summary statistics describing the characteristics of the data set.

Figure 3. Frequency Histogram and Fitted Normal Curve
of Linear Model Results

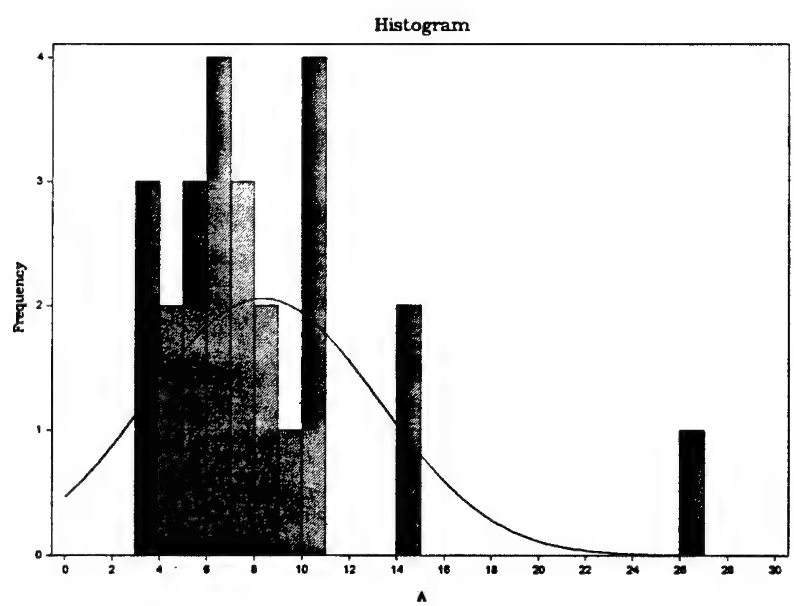


Table 8. Summary Statistics

Mean	Median	Standard Deviation	Variance	Minimum	Maximum	Skewness	Kurtosis
7.84	7.00	4.85	23.56	3	26	4.81	7.74

An examination of the summary statistics indicated that this data may not come from a normal distribution, as indicated by the skewness and kurtosis scores above +2.00. In order to determine if the data can be adequately fit by a normal distribution, the Kolmogorov-Smirnov test was performed. This test was chosen over the chi-square test because the minimum expected frequency in each bin of the histogram was not met. The results of this test are shown below:

Ho: $E_i = O_i$ (normal distribution)   Computed D-statistic = 0.208145
Ha: $E_i \neq O_i$ (not from normal)   P-Value = 0.229395
$\alpha = 0.05$
where: E_i = expected frequency
O_i = observed frequency

Conclusion: Fail to reject the null hypothesis for $\alpha = 0.05$

Since the P-value is greater than 0.05, we fail to reject the null hypothesis Therefore, it was concluded that the distribution was normally distributed.

In order to determine how well the linear model's results matched the actual CCAS Team staffing level of 8 personnel during Operation Uphold Democracy, a Student's t-test was conducted on the data with the following results:

Ho: $\mu = 8$ Computed t - statistic = -0.164829
Ha: $\mu \neq 8$ P - Value = 0.870459
$\alpha = 0.05$

Conclusion: Fail to reject the null hypothesis for $\alpha = 0.05$

Since the P-value is greater than 0.05, we fail to reject the null hypothesis. Therefore, the mean manning level predicted by model is not statistically different from the actual manning level during Operation Uphold Democracy. This would tend to validate the usefulness of this model for determining prospective staffing demands.

Objective Center Manpower Model

This model was run once for each of the two phases of Operation Uphold Democracy in which data was available. A comparison between the numbers predicted by the model and the actual staffing level is shown in Table 7.

Table 9. Comparison of Objective Center Manpower Model Results to Actual Staffing Level

Phase	**Population**	**Predicted Staffing**	**Actual Staffing**	**Delta**
Deployment and Stabilization	18,000	51.2	8	43.2
Sustainment	6,000	19.4	8	11.4

As can be seen in the above table, there are significant differences between the model's predicted staffing level and the actual staffing level during Operation Uphold Democracy.

Summary

This chapter reported the results generated by the USACERL model and the Objective Center Manpower model after adaptation to CCAS team staffing. The USACERL model is an application of LP procedures which yielded an average of 7.84 personnel required to staff a CCAS team, while the actual staffing level during Operation Uphold Democracy was 8 personnel. Statistical analysis on these results indicates that this model may be useful in determining staffing levels.

The Objective Center Manpower model is an application of linear algebra techniques, which yielded a staffing level of 51.2 and 19.4 for deployment / stabilization and sustainment phases respectively for Operation Uphold Democracy. Significant differences between the model's predicted numbers and the actual staffing level exist which may invalidate the usefulness of this model for determining contingency contracting operations staffing levels.

V. Discussion, Conclusions and Recommendations

Chapter Overview

This chapter begins by discussing the meaning and importance of the results obtained in the adaptation process of each model. Following the discussion of the results are the author's conclusions concerning the study's findings and its limitations. Finally this chapter ends with the author's recommendations for the further study needed on this subject in light of the research question, *"Which of the most commonly employed CONUS manning model methodologies offers the best practical solution to the problem of staffing a contingency contracting operation?"*

Discussion

The primary objective of this research was to help DCMC contingency contract administration planners to find an effective way to prospectively determine the required staffing levels for CCAS teams which must administer LOGCAP type contracts during contingency operations. Three manning models, developed for use in CONUS contracting organizations, were examined to determine their usefulness in developing a contingency contract administration manning model that can help the DCMC planner determine proper staffing levels for CCAS Teams.

Linear Programming Model

This model predicted on average that 7.84 personnel were required to staff a CCAS team. As Figure 2 in Chapter IV indicates, the majority of the outcomes cluster around the actual staffing number of 8. One reason for such an outcome is that the expert panel was accurate in their assessment of the taskings and levels of effort. Another

explanation could be that the adjustments made to the workload variables were not significantly different from the baseline workload variables and as such, did not greatly alter the outcomes. In either case it is important to note that the primary determinant of this model, workload demand, is useful for determining staffing levels.

Though this study's adaptation of the USACERL model seems to be successful in reasonably determining the required number of personnel based on workload estimates, there are a number of limitations that restrict the success of the outcome. The first limitation is that the workloads were estimated by a panel of experts rather than gathered from actual time and task accounting data from DCMC records. If such time and task data were available, the model's results would have been more representative of the actual population of contingency contract administration efforts.

Another factor limiting the success of the linear model is the lack of environment defining variables. As discussed in Chapter III, the USACERL model includes additional variables such as distance between work sites, number of work sites, skills required at the work site and the travel time between the sites and the base(s) of operation. These variables further define the operating environment and their relationship in which the contract administration personnel operate. However, environmental variables such as infrastructure, cultural barriers, operating tempo, and phase of the operation may capture some of the more subtle factors that influence the operating environment.

Also limiting this model is the fact that data required to run the model is only available in the future as far as analyzing a current contingency operation The only method for accurately estimating the present workload is to examine the workloads of

completed contingency operations. Once the influencing effects of these variables can be assessed, they can be adjusted as necessary based on the situational realities, making the model more useful for determining contingency contract administration staffing levels.

The linear model in its original formulation as prescribed by Williamson & Hicks can be readily adapted to a contingency environment if the proper data is available. If the data required is not accessible, as was the case for this effort, heuristics based on expert analysis may be substituted. At a minimum, the types of tasks performed, the time required for these tasks, and the frequency of task are needed to develop the model.

When the above mentioned data can be reasonably estimated from previous operations or ascertained by the complexity of the contracting tasks, this model can be readily adapted and serve as an excellent tool for DCMC planners to use to estimate the number of personnel required to administer the LOGCAP contract during contingency operations.

AFMC Objective Center Manpower Model

This model predicted 51.2 personnel for the deployment and stabilization phase and 19.4 personnel for the sustainment phase of a contingency operation. Based on the nature of the job performed by the CCAS Team and the author's experience, both of these numbers are unusually high, and are a result of a number of circumstances that limit the model's adaptability to contingency contract administration.

First of all the basic assumption that a linear relationship exists between troop strength and contracting support is only true to a point. This model ignores the cumulative effects of adding additional persons to the team. As more and more persons

are added the slope of the line should become less and less steep indicating a quadratic rather than a linear relationship due to the pooling of knowledge, skills and task overlap allowed by adding additional personnel.

Another limitation to this model is the inability in the present study to accurately determine and score the environmental variances which may affect the staffing level. Significant changes or challenges in the contingency environment affect the services the LOGCAP contractor provides and consequently the contract administration support. If the operation commander decides additional troops are required to carry out the mission, additional lodging must be obtained or constructed, additional food services must be acquired or augmented, transportation secured, etc., when the new forces arrive. These variances necessitate changes such as modifications to existing contracts, solicitation of new contracts, scheduling of quality assurance inspections, and acquiring government property. Each of these variances increases or decreases the workload on the existing contracting personnel, necessitating the additional or reduction of personnel and extending or reducing working hours. Accurately identifying and estimating the effects of these variances on the CCAS team staffing requirements is essential to the success of this model in adapting it to contingency contract administration.

This model is an efficient means of determining staffing levels in a CONUS operational contracting organization. The only data required are the troops to be supported by the contracting organization and the scoring of each of the identified variances. Since this model generated unusually large numbers for staffing the contract administration office as a result of the inability to accurately represent the contingency

environment, it is not recommended for use by DCMC planners for determining CCAS Team staffing levels in its present form. Additional work is necessary to asses the situational realities and environmental variances, which would make the model more useful for determining contingency contract administration team staffing levels.

Conclusion and Recommendations

This research examines three methods used by CONUS contracting organizations to determine staffing levels. During the course of this study, an examination of each manning model and its adaptability to determining CCAS Team personnel requirements revealed that the linear programming technique, as employed by USACERL Model, is the most useful. The linear programming technique captures the effect of the primary resource constraint during a contingency, time. As described in Chapter two, contingencies are usually 24 hour a day operations with an increased tempo. With such constant activity, time becomes a premium. However, the ultimate manning decision is based on a combination of objective criteria (mathematical models) and subjective criteria (organizational goals, organizational culture, and policies).

Since this study lays the groundwork in developing a model for DCMC planners to utilize when deciding the required CCAS team staffing, there is an opportunity for further research. First of all, there are a number of manning models that were not analyzed in this study for possible adaptation. Jaquette, Nelson & Smith identify and analyze over 26 different manpower models in their study, An Analytic Review of Personnel Models in the Department of Defense. A similar methodology, as one

employed in the current research effort, may be employed in analyzing these models to determine the feasibility of adapting them to contingency contract administration.

The areas that specifically need development in future research efforts are: (a) determining environmental variances and their weighting factors, and (b) the way in which all of the environmental and resource variables interact.

Determining the environmental variances, their associated scores, and how they interact with resource variables may be accomplished through discussions with personnel who have participated in contingency operations. Such an analysis would provide insight as to how each military function operates during a contingency as well as how mission and environmental changes affect their operations. Having this insight not only contributes to identifying and scoring the environmental variances, it also helps contracting personnel understand the impact of providing effective contract support. This understanding can further enhance the decision making process that DCMC planners must make in determining CCAS team staffing.

Appendix A: Glossary of Acronyms

AAA	- Army Audit Agency
AFB	- Air Force Base
AFCAP	- Air Force Civil Augmentation Program
AFMC	- Air Force Material Command
ASC	- Aeronautical Systems Center
CCAS	- Contingency Contract Administration Services
CONUS	- Continental United States
DCMC	- Defense Contract Management Command
DoD	- Department of Defense
FAR	- Federal Acquisition Regulation
GAO	- General Accounting Office
GOCESS	- Government Owned Civil Engineering Store
IMPAC	- International Merchant Purchase Authorization Card
JCS	- Joint Chiefs of Staff
LOGCAP	- Logistics Civil Augmentation Program
LP	- Linear Programming
MAJCOM	- Major Command
OMB	- Office of Management and Budget
QA	- Quality Assurance
USACERL	- U.S. Army Corps of Engineers Research Laboratory

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Vita

Captain Anthony Lomelin was born on October 23, 1970, in Hammond, Indiana. He graduated third in his class at Calumet High School in Gary, Indiana on June 6, 1989. Two weeks later he entered the U.S. Air Force Academy. On June 2, 1993, Captain Lomelin graduated with a Bachelor of Science in Biology, was commissioned, and entered "the real Air Force." His first assignment was with the Defense Logistics Agency, Defense Contract Management Command, at Northrop Grumman Corporation in Los Angeles. Captain Lomelin administered contracts for the Air Force's B-2 and F-5 programs, and the Navy's BQM-73 target program. In addition to these duties, Captain Lomelin participated in Operation Uphold Democracy in the Republic of Haiti during the summer of 1995. While in Haiti, Captain Lomelin administered the U.S. Army's Logistics Civil Augmentation Program contract, providing logistics support services to U.S. and U.N. forces during the contingency operation. Upon graduation from the Air Force Institute of Technology, Captain Lomelin will be assigned to the operational contracting office at the Aeronautical Systems Center, Wright-Patterson AFB.

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13. ABSTRACT *(Maximum 200 Words)*

Internationally, the U.S. military has participated in numerous contingency operations in which the Defense Contract Management Command (DCMC) has provided contract administration for logistics support contracts. Ascertaining an effective and efficient staffing level for a DCMC contingency contract administration team during these operations has become a concern for DCMC. This thesis investigates different manpower models used by stateside contracting organizations which may be useful for determining staffing for contingency contract administration teams. Specifically this thesis seeks to determine which manning model methodologies offer the best practical solution to contract administration team staffing during contingency operations. This research suggests that certain features of the contingency environment, such as increased operating tempos, infrastructure, culture, and troop strength, all interact to affect the level of contracting support required during a contingency operation. The results of the study discussed here suggest that manning models which use work load taskings as their primary driver are the most useful in determining contingency contracting staffing levels. While the researcher offers no significant results, important contributions are made in laying the groundwork for understanding the staffing problem and developing a realistic manning model.

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